is very similar to that of acids; abundant proof of this is afforded especially by F. Kohlrausch's refined measurements, of which an account has recently been published (*Wied. Ann.*, 1886, xxvi., p. 162). I venture to think that a similar explanation to that above given for oxides will apply to salts; and also that the low molecular conductivities of salts as compared with corresponding acids may be regarded as confirmatory of my hypothesis. I think we must admit that the metals generally have less affinity than hydrogen for negative radicles; if this be granted, we have at once an explanation of the fact that metallic salts are mostly fixed solids, few of which are more than moderately soluble in water while many are very difficultly soluble or insoluble, whereas the corresponding acids are mostly volatile and readily soluble in water, if not miscible with it in all proportions. The affinity of the negative radicles being less exhausted by union with metals than with hydrogen, the fundamental molecules of salts are more prone to unite together to form complex aggregates.

Arrhenius, who has studied the electrical behaviour of solutions of a number of salts, attributes the change observed in molecular conductivity on dilution—as I have done—to molecular changes; but his deductions are all based on the acceptance of the Williamson-Clausius hypothesis of dissociation.

My hypothesis would also account for the increase in conductivity in composite electrolytes with rise of temperature. It is true that as temperature rises the influence which individual molecules exert upon each other would be lessened; but, on the other hand, the complex aggregates would become more and more completely resolved into their fundamental molecules, the velocity of molecular motion would increase, and the tendency of the constituent atoms to remain united would be lessened. From this point of view the determination of the coefficient of change of conductivity with temperature in the case of substances whose molecular conductivity increases considerably on dilution in comparison with allied compounds which exhibit only a slight variation in molecular conductivity on dilution affords an interesting subject for investigation. F. Kohlrausch has already pointed out (*Pogg. Ann.*, 1875, cliv., p 236) that in the case of all neutral salts, "der Einfluss der Temperatur auf das Leitungsvermögen mit wachsender Verdünnung sich Anfangswerthen nähert, die zwischen engen Gränzen liegen;" and the experiments of F. Kohlrausch and Nippoldt on solutions of sulphuric acid (*ibid.*, 1869, cxxxviii., p. 286) show that the resistance diminishes to a much greater extent for equal increments of temperature in concentrated than in dilute solutions.

As concentrated solutions would be richer in complex aggregates than dilute solutions, these results are in entire accordance with my hypothesis: it does not appear to me that they can be satisfactorily interpreted in terms of the dissociation hypothesis.

In cases where the influence of the one member of the composite electrolyte upon the other is but slight, it may happen that the effect of temperature in diminishing this influence will outweigh that due to molecular simplification, and that, in consequence, conductivity will diminish with rise of temperature; a mixture of alcohol and ether would appear to furnish an example of this kind: according to Pfeiffer's recent observations (*Wied. Ann.*, 1886, xxvi., p. 216), such a mixture behaves as a metallic conductor of very high resistance.

The increase in conductivity of graphite and gas-retort carbon on heating, and the effect of light on the conductivity of (? impure) selenium and some other substances (Shelford Bidwell, Phys. Soc. Proc., pp. 122, 256), appear to me to be also explicable on the assumption that in all these cases we are dealing with composite electrolytes.

If any further proof be needed of an intimate connexion between molecular composition and electrolytic conduction, it is most conclusively afforded, I think, by the observations of W. Kohlrausch on chloride, bromide, and iodide of silver (*Wied. Ann.*, 1882, xvii., p. 642). In the fused state, these compounds are better conductors than the most highly-conducting mixture of sulphuric acid and water, which of all liquids is the best conductor at ordinary temperatures, but when the change from the fused to the solid state sets in the resistance of both silver chloride and bromide suddenly increases. No such change takes place, however, in the case of silver iodide. This iodide fuses at 557° according to Rodwell, but at about 540° according to Kohlrausch; its electrical resistance increases only gradually after it has become solid, and remains almost a linear function of the temperature during an interval of 400°, until suddenly at near 150° it increases enormously, this change taking place at the moment when, according to Rodwell (Phil. Trans., 1882, p. 1153), it passes from the transparent, plastic, amorphous solid to the opaque, crystalline state, the volume increasing considerably. Kohlrausch has proved most conclusively that the solid iodide may undergo electrolysis. It would seem that almost immediately after solidification in the case of silver chloride and bromide practically the whole mass consists of complex aggregates so constituted as to be exceedingly bad conductors, but that such aggregates are formed much less readily by silver iodide.

(*To be continued.*)

THE MAZAPIL METEORIC IRON[1]

AMONG the large number of meteoric irons which have been described, only eight[2] are recorded as having been seen to fall. It is my privilege to be able to add a ninth fall to this short list, and one which may prove to be of exceptional scientific importance. This mass of meteoric iron I received in August last as a gift from my friend, Prof. José A. y Bonilla, Director of the Astronomical Observatory at Zacatecas, Mexico. He stated that it was *seen to fall* at about 9 p.m. on November 27, 1885, during the periodical star-shower of the "Bielids." Such is the unique interest of this meteorite, as shown by its history, that I have delayed announcing it until the evidence of its fall had been substantiated as thoroughly as possible.

The general freshness of surface, which shows very perfectly the flow of the melted crust; the presence of unusually large nodules of a very compact graphite; the very slight superficial oxidation, and its dissimilarity to other meteorites of the region, are all interesting features of this iron, and serve to confirm the statement of its recent fall. When received it weighed about 3950 grammes. Its present weight is 3864 grammes, or 10 pounds 4¼ ounces, troy. Its greatest length is 175 millimetres as measured diagonally across the mass. In its thickest part it measures about 60 millimetres. It could be described as a flat irregular mass, covered with deep depressions, having a smooth surface (see Fig. 1).

The evidence of the fall is set forth in the following communication from Prof. Bonilla.

(Translation).—"It is with great pleasure that I send to you the uranolite which fell near Mazapil, during the night of November 27, 1885. That you may the better appreciate the great scientific interest which this uranolite possesses, I will state that everything points to the belief that it belongs to a fragment of the comet of Biela-Gambart, lost since 1852. I here give you the history of this celestial wanderer. On December 2 (1885) I received, to my great delight, from Eulogio Mijares, who lives on the Conception Ranch, 13 kilometres to the east of the town of Mazapil, a uranolite, which he saw fall from the heavens, at nine o'clock on the evening of November 27, 1885. The fall, simply related, he tells as follows, in his own words:—

"'It was about nine in the evening when I went to the corral to feed certain horses, when suddenly I heard a loud hissing noise, exactly as though something red-hot was being plunged into cold water, and almost instantly there followed a somewhat loud thud. At once the corral was covered with a phosphorescent light and suspended in the air were small luminous sparks as though from a rocket. I had not recovered from my surprise when I saw this luminous air disappear and there remained on the ground only such a light as is made when a match is rubbed. A number of people from the neighbouring houses came running toward me and they assisted me to quiet the horses which had become very much excited. We all asked each other what could be the matter, and we were afraid to walk in the corral for fear of getting burned. When, in a few moments, we had recovered from our surprise, we saw the phosphorescent light disappear, little by little, and when we had brought lights to look for the cause, we found a hole in the ground and in it a ball of fire. We retired to a distance, fearing it would explode and harm us. Looking up to the sky we saw from time to time exhalations or stars, which soon went out, but without noise. We returned after a little and found in the hole a hot stone, which we could barely handle, which on the next day we saw looked like a piece of iron; all night it rained stars, but we saw none fall to the ground as they seemed to be extinguished while still very high up.'

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[1] From the March number of the *American Journal of Science*, vol. xxxiii. pp. 221–26.

[2] Agram, Croatia, May 26, 1751; Charlotte, Dickson Co., Tenn., August 1, 1835; Braunau, Bohemia, July 14, 1847; Tabarz, Saxony, October 18, 1854; Victoria West, Africa, in 1862; Nejed, Arabia, spring of 1865; Nedagolla, India, January 23, 1870; Rowton, Shropshire, England, April 20, 1876. See the Catalogue of the Meteorites in the Mineral Department of the British Museum, by L. Fletcher, p. 42.

"The above is the simple recital of the ranchman, and the uranolite which fell is the one I send to you. From the numerous questions I have asked Sr. Mijares, I am convinced that there was no explosion or breaking up on falling. Others who saw the phosphorescence, &c., were Luz Sifuentes, Pascual Saeuz, Miguel Martinez, Justo Lopez, and some whose names I have not obtained. Upon visiting the place of the fall I was particular to examine the earth in and around the hole, and by careful search and washing the earth I found a few small bits of iron, which must have become detached from the uranolite when it penetrated the earth.

"The hole was 30 centimetres deep. Probably the light which was seen came from the volatilisation of the surface of the celestial body due to the high temperature acquired by friction with the atmosphere, and of this volatilised matter falling to the earth as an incandescent powder."

The above communication was followed by an account of the observation of the Biela meteors at Zacatecas by Prof. Bonilla and his assistants. (See Annals N.Y. Acad. Sci. 1887.)

The locality of the fall is situated in latitude 24° 35′ N. and in longitude 101° 56′ 45″ West of Greenwich.

That no explosion was heard when this iron fell, is paralleled by the account of the fall of the fifty-six pound aërolite near Wold Cottage, Yorkshire, England, on December 13, 1795. "This stone fell within 10 yards of where a labourer was at work. No thunder, lightning, or luminous meteor accompanied the fall; but in two of the adjacent villages the sounds were so distinct of something passing through the air towards Wold Cottage that several people went to see if anything extraordinary had happened to the house or the grounds" (L. Fletcher, "An Introduction to the Study of Meteorites," 1886, p. 22). Concerning the aërolites which fell at 11.50 a.m., on June 28, 1876, at Ställdalen, in Sweden, "it is remarkable that no meteor was visible at the place where the stones fell, though it was seen over nearly all Sweden."

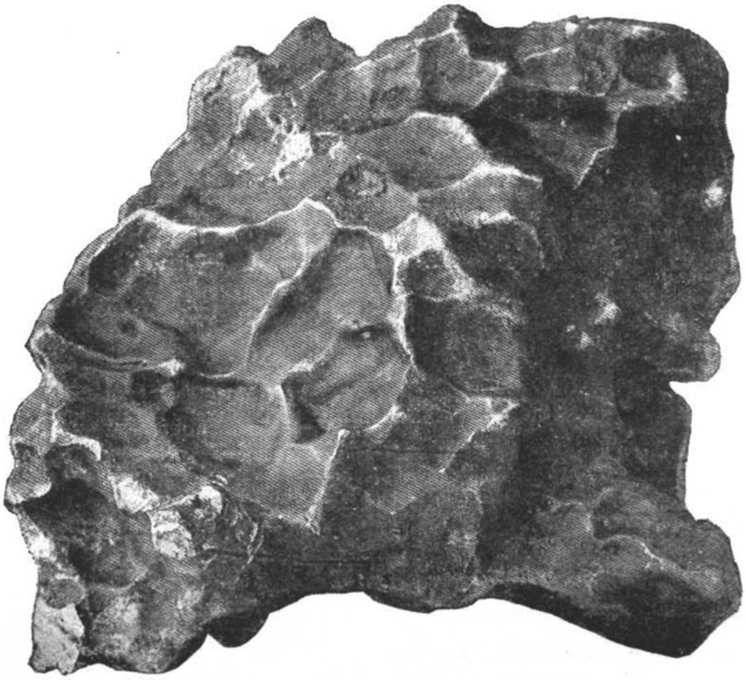

FIG. 1.—Mazapil Meteoric Iron. Weight 10 lbs. $4\frac{1}{4}$ oz. troy ($\frac{3}{4}$ natural size.)

The surface of the Mazapil iron is of great interest. The deeply hollowed depressions entirely cover the mass (see Fig. 1). A thin black crust coats the surface, and exhibits well the striæ of flow, as seen on meteorites whose fall has been observed. In eleven places nodules of graphite are noticed extruding from the surface (the engraving shows some of these), one of them is nearly an inch in diameter. The graphite is very hard and apparently amorphous; troilite and schreibersite were noticed on a section cut off for analysis and for the development of the figures of Widmanstätten. The crystalline structure (see Fig. 2) is well shown in the engraving (Ives' process) which is of natural size. The lines are somewhat similar to that of the Rowton iron in their width and distribution, and are very unlike the known Mexican irons from Toluca, &c.

In its surface and general flatness the mass bears a remarkable resemblance to the Hraschina, Agram, iron[1] which fell May 26, 1751. In its weight it is nearly like the irons of Rowton ($7\frac{3}{4}$ lbs.), Charlotte ($9\frac{1}{2}$ lbs.), Victoria West (6 lbs. 6 ozs.), and Nedagolla ($9\frac{3}{4}$ lbs.), which were all seen to fall.

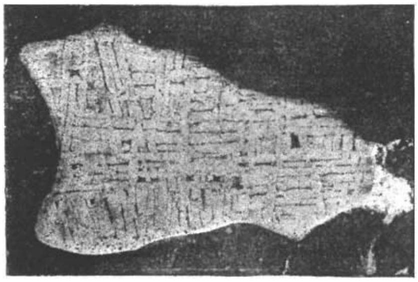

FIG. 2.—Section of Mazapil Meteoric Iron (natural size.

[1] See "Beiträge zur Geschichte und Kenntniss meteorischer Stein-und Metalmassen," by Dr. Carl von Schreibers, Wien, 1820, plate viii.

Mr. J. B. Mackintosh has kindly analysed a small fragment with the following results, which, for comparison with other irons seen to fall, I have placed in tabular form :—

	Mazapil.	Rowton. Flight.	Charlotte. Smith.	Estherville.[1] Smith.
Iron............	91·260	91·250	91·15	92·000
Nickel.........	7·845	8·582	8·05	7·100
Cobalt	0·653	0·371	0·72	0·690
Phosphorus...	0·300	......	0·06	0·112
	100·058	100·203	99·98	99·902

Carbon is distributed all through the iron between the crystalline plates, and it is noteworthy that this element was observed with the spectroscope as present, in the "Bielids" of November 27, 1885. Chlorine is also present and shows itself by a slight superficial deliquescence. Of this latter I will state that most of the surface oxidation of the ferrous chloride has occurred since August last. As yet no tests have been made to ascertain the amount of occluded gases, or to analyse the graphite nodules, and it is probable that this might only lead to results similar to those already obtained. Over the mass, where the crust has been accidentally removed, the lines of crystallisation (Widmanstätten figures) can readily be traced without etching the surface. The abrasion due to impact was very slight.

In conclusion, we cannot, from the very circumstantial account of the fall, and the corroborative evidence of the iron itself, which in several particulars contains heretofore unrecorded observances, decline to receive this meteorite as the ninth recorded fall of an iron mass to the earth ; and perhaps at another period of the November "Bielids" this fall will be confirmed in all its interesting details. The interest connected with this meteorite, because of its beautifully marked and fresh surface, is enhanced by the concurrence of the time of its fall with the shower of the Biela meteors.

I wish to express here my deep obligation to Prof. Bonilla for the interesting data concerning this meteorite and for the gift of the meteorite itself, and to Mr. Mackintosh also for his kind interest in making the chemical analysis.

William Earl Hidden

SOCIETIES AND ACADEMIES

London

Royal Society, March 24.—"On Ellipsoidal Current Sheets." By Horace Lamb, M.A., F.R.S.

The paper treats of the induction of electric currents in an ellipsoidal sheet of conducting matter whose conductivity per unit area varies as the perpendicular from the centre on the tangent plane, or (say) in a thin shell of uniform material bounded by similiar and coaxial ellipsoids. The method followed is to determine in the first instance the normal types of free currents.

When the normal types and their persistencies have been found, it is an easy matter to find the currents induced by given varying electromotive forces. Supposing that we have an external magnetic system whose potential varies as e^{ipt}, we can determine a fictitious distribution of current over the shell, which shall produce the same field in the interior. If $\bar{\phi}$ denote the current-function for that part of the distribution which is of any specified normal type, ϕ that of the induced currents of this type, it is shown that

$$\phi = -\frac{ip\tau}{1 + ip\tau}\bar{\phi},$$

where τ is the corresponding persistency of free currents. When $p\tau$ is very great this becomes

$$\phi = -\bar{\phi},$$

in accordance with a well-known principle.

This method can be applied to find the currents induced by rotation of the shell in a constant field, it being known from Maxwell's "Electricity," § 600, that the induced currents are the same if we suppose the conductor to be fixed, and the field to rotate in the opposite direction. When the conductor is symmetrical above the axis of rotation, the current-function of any normal type contains as a factor cos $s\omega$ or sin $s\omega$, where ω is the azimuth, and s is integral (or zero). When we apply Maxwell's artifice, the corresponding time-factor is e^{ispt}, where p is the angular velocity of the rotation ; and we easily find that the system of induced currents of any normal type is fixed in space, but is displaced relatively to the field through an angle,

$$\frac{1}{s} \text{ arc tan } ps\tau$$

in azimuth, in the direction of the rotation.

In the most important normal types the distribution of current over the ellipsoid is one which has been indicated by Maxwell ("Electricity," § 675) as giving a uniform magnetic field throughout the interior.

In the higher types the current-function ϕ is a Lamé's function, degenerating into a spherical harmonic when two of the axes of the ellipsoidal shell are equal. Of the special forms which the conductor may assume, the most interesting is that in which the third axis (that of symmetry) is infinitesimal, so that we have practically a circular *disk*, whose resistance ρ' varies according to the law

$$\rho' = \rho_0' \sqrt{\{1 - r^2/a^2\}},$$

where ρ_0' is the conductivity at the centre, a is the radius, and r denotes the distance of any point from the centre. In the most persistent type

$$\tau = \frac{\pi^2 a}{2\rho_0'}.$$

This result is of some interest, as showing that the electrical time-constant for a disk of *uniform* resistance ρ_0' must at all events be considerably less than 4·93 a/ρ_0'.[1]

The problem of induced currents is then discussed, more particularly in the case of a circular disk, of the kind indicated, rotating in any constant magnetic field. In view of the physical interest attaching to the question, it would be interesting to have a solution for the case of a *uniform* disk ; but in the absence of this, the solution for the more special kind of disk here considered may not be uninstructive.

In the most important types of induced currents, the magnetic potential $\bar{\Omega}$ due to the field $\propto xz$, so that the lines of force at the disk are normal to it, but the direction of the force is reversed as we cross the axis of z. The current-function relatively to axes displaced through the proper angle η in the direction of rotation, varies as

$$y \sqrt{\left\{1 - r^2/a^2\right\}}.$$

In the next type $\Omega \propto z(x^2 - y^2)$, and the current-function, relatively to displaced axes as before, varies as $xy \sqrt{1 - r^2/a^2}$.

"Note to a Memoir on the Theory of Mathematical Form" (Phil. Trans. 1886, vol. clxxvii. p. 1). By A. B. Kempe, M.A., F.R.S.

The object of this note is to make some slight but important amendments of certain sections of the original memoir (viz. secs. 5, 7, 73 to 77, and 167), relating to the definition and use of what the author terms "aspects" of collections of things. An "aspect" of a collection of n things is that which is under consideration when to each individual thing of the collection we mentally affix a distinctive degree of prominence or other mark. These n marks may be regarded as interchangeable with each other, and we thus get $\underline{|n}$ aspects of the collection, of which some are undistinguishable from each other. If the interchanges corresponding to a complete system of undistinguishable aspects of the collection are given we know the "form" of the collection.

March 31.—"On Clausius's Characteristic Equation for Substances applied to Messrs. Ramsay and Young's Experiments on Alcohol." By Prof. Fitzgerald, Trinity College, Dublin.

This paper is an investigation of how far Clausius's equation

$$\frac{P}{R\tau} = \frac{1}{v - \alpha} - \frac{1}{\odot(v + \beta)^2}$$

represents accurately Messrs. Ramsay and Young's experimental results. It is shown that, considering the enormous range of values to be represented, it represents the results remarkably accurately, except that from the volume of the liquid, where alone the value of α is of much consequence, it follows that α is not constant, but is a function of both the temperature and pressure.

The paper contains a short discussion of the geometrical forms of the curves—a particular case of which is represented by this equation.

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[1] Fell May 10, 1879, and contained embedded nodules of nickeliferous iron surrounded by silicates.

[1] I find by methods similar to those employed by Lord Rayleigh for the approximate determination of various acoustical constants, that the true value lies between $\pi a/\rho'$ and 2·26 a/ρ'. For a disk of copper (ρ=1600 C.G.S.), whose radius is a decimetre and thickness a millimetre, the lower limit is 0·0014 sec. For disks of other dimensions the result will vary as the radius and the thickness conjointly.